



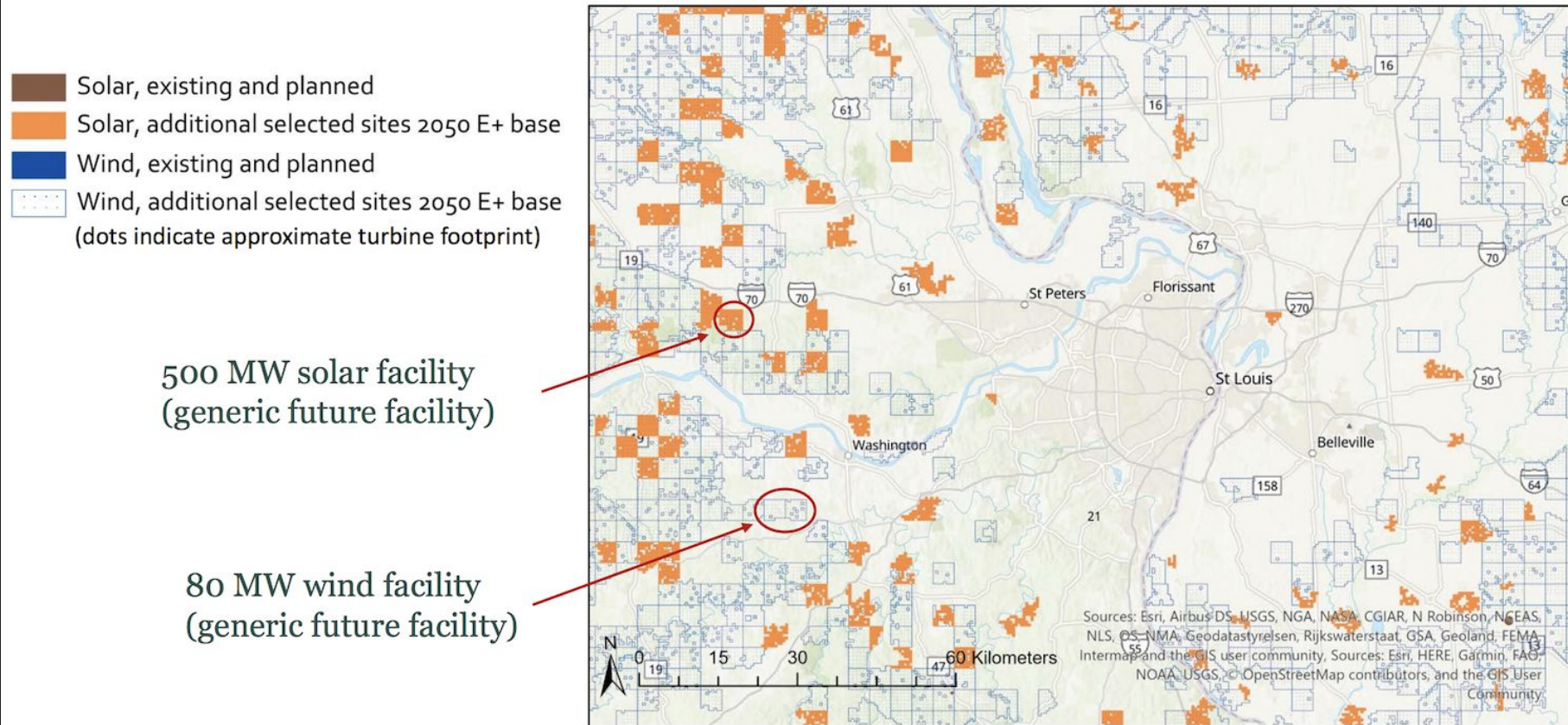
What New Net-Zero Studies Tells Us About Electricity Decarbonization

Zeke Hausfather
February 25th, 2021

Three recent high-res grid integration modeling studies

- Princeton Net Zero Alliance (NZA)
 - Uses the EnergyPATHWAYS (EP) and RIO models
 - Scenarios examined: E+, E-, E-B+, E+RE-, E+RE+
- Williams et al 2021: Carbon-Neutral Pathways for the United States
 - Also uses EnergyPATHWAYS (EP) and RIO models
 - Scenarios examined: Central, Low Fossil Fuel Price, Low Renewables Cost, Low Land, Delayed Electrification, Low Demand, 100% Renewable Primary Energy, and Net Negative.
- Vibrant Energy Zero By Fifty scenario
 - Uses the WIS:dom model
 - Only the central scenario available so far.

High resolution assessment of siting and transmission



High resolution assessment of siting and transmission

Transmission & generators.

Note: Capacity factors at generator sites are reflected in color intensity, with highest CF = darkest color.

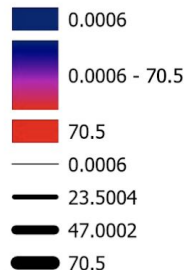
2020 transmission capacity:

~320,000 GW-km

2050 transmission capacity:

~1,012,000 GW-km (3.2x)

Transmission Capacity (GW)

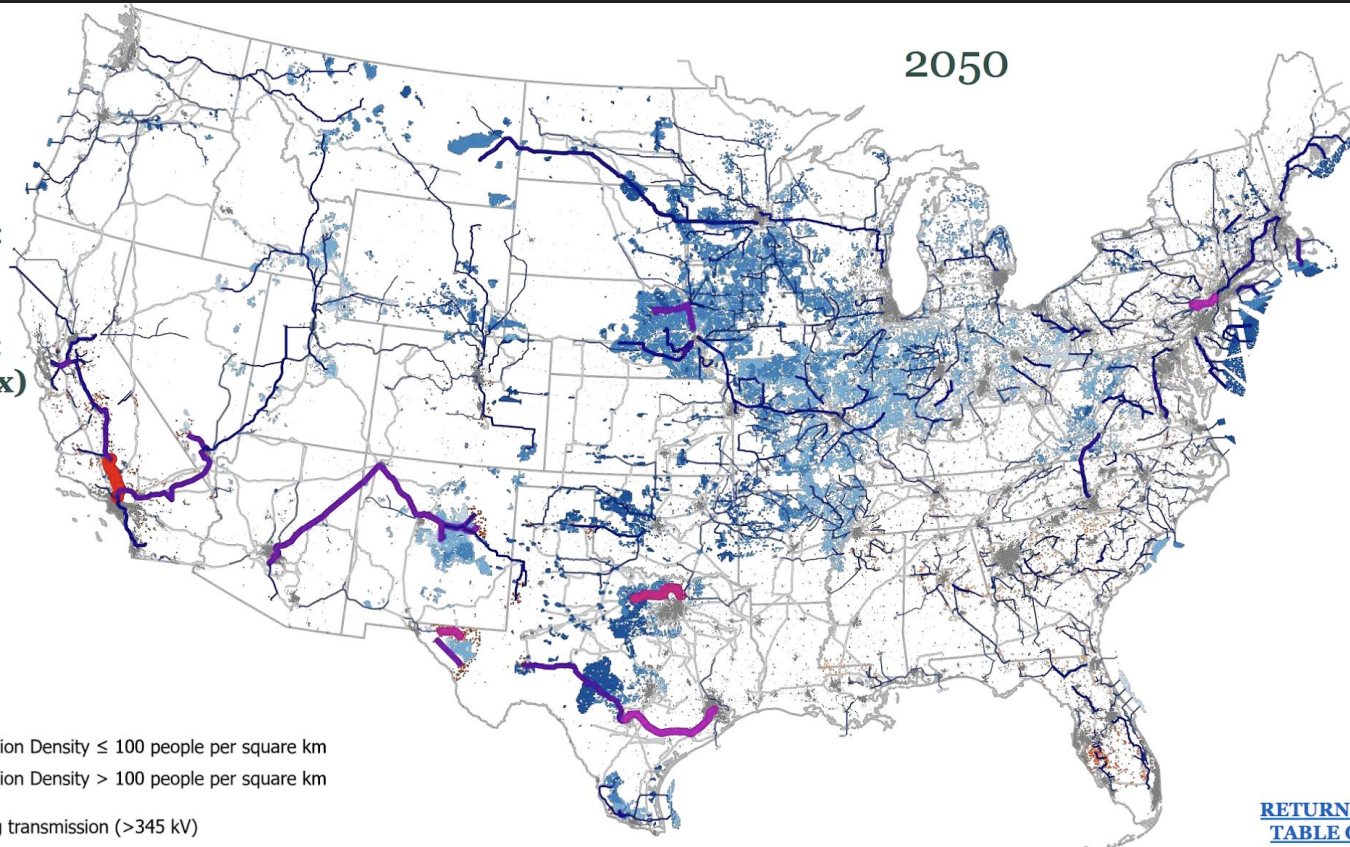


PV
Wind

Population Density ≤ 100 people per square km

Population Density > 100 people per square km

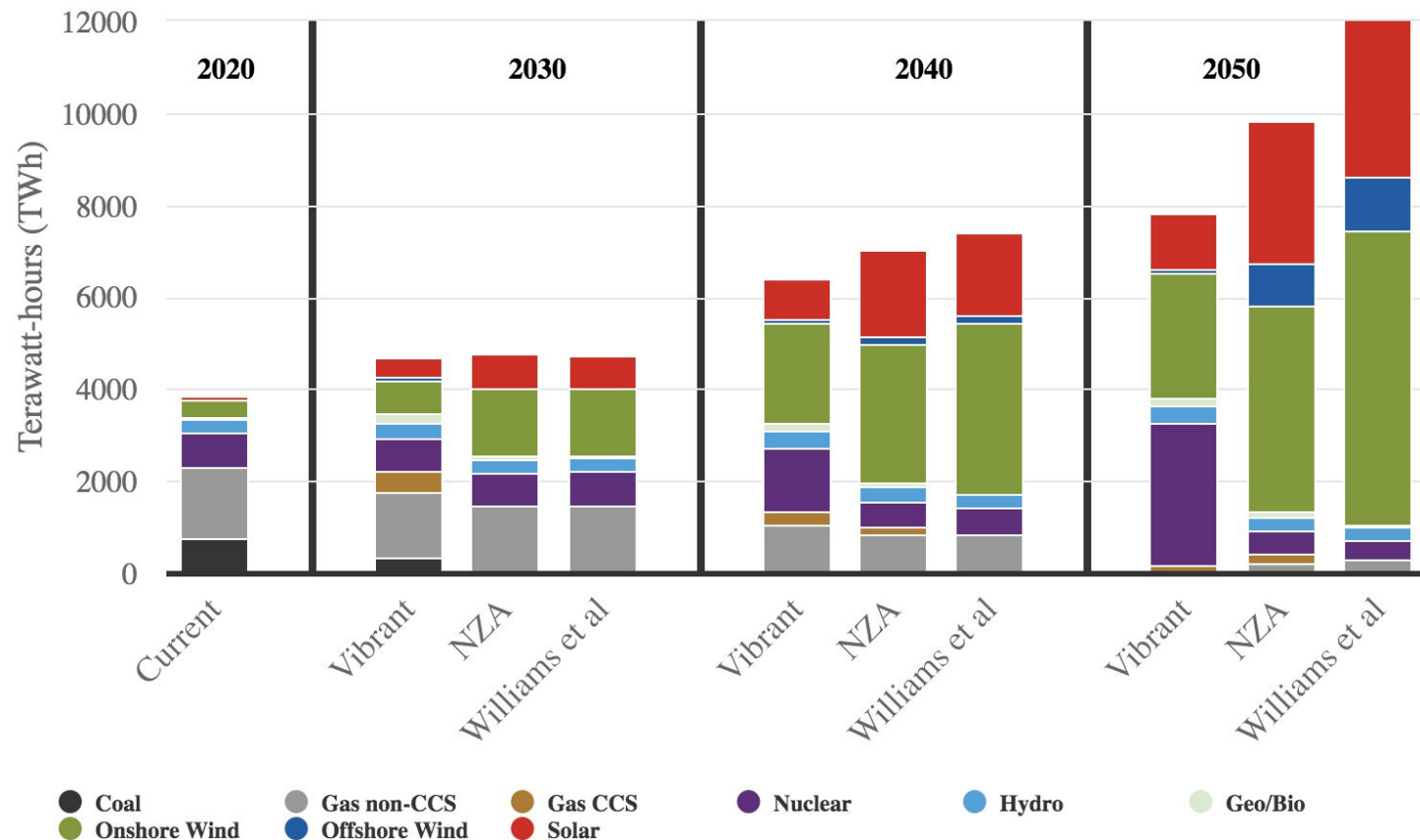
Existing transmission (>345 kV)



Note: Transmission expansion is visualized along existing rights of way (>160 kV); paths are indicative not definitive.

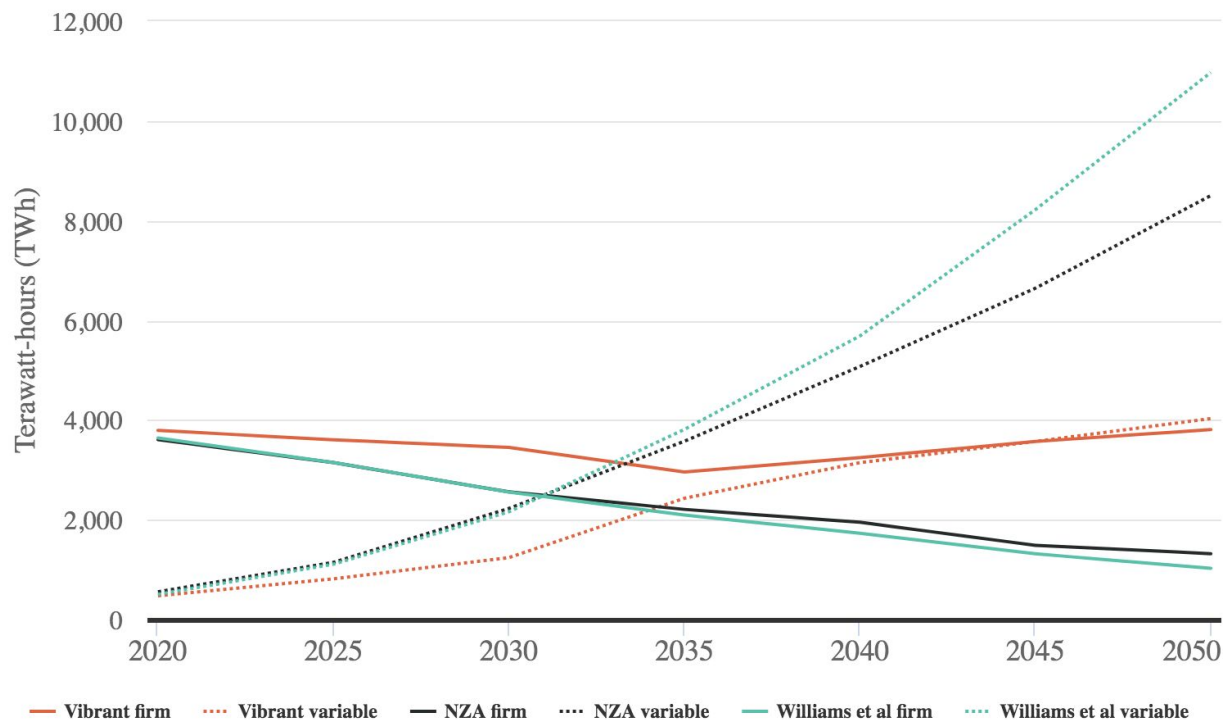
[RETURN TO
TABLE OF
CONTENTS](#)

Electricity generation mix across different decarbonization models



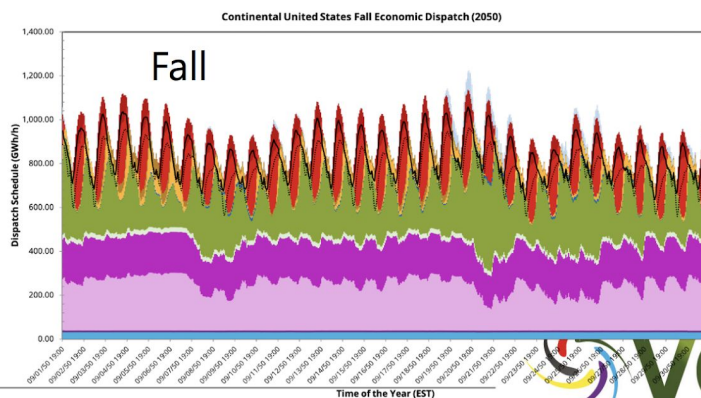
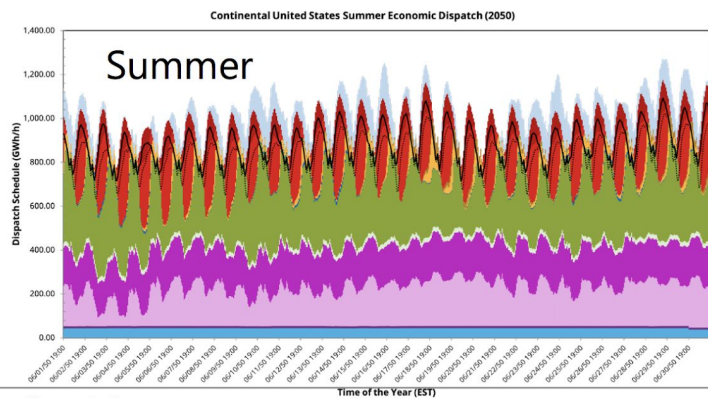
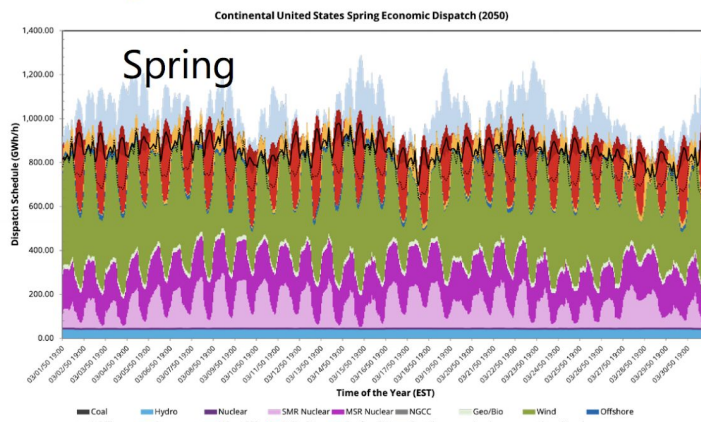
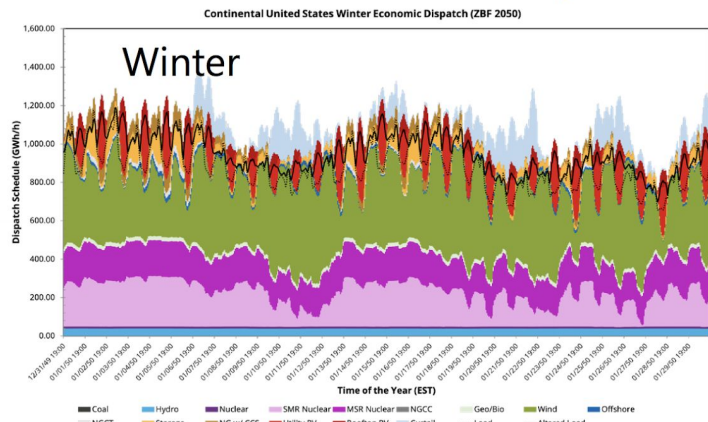
Different visions of firm vs variable clean energy

Firm and variable generation over time



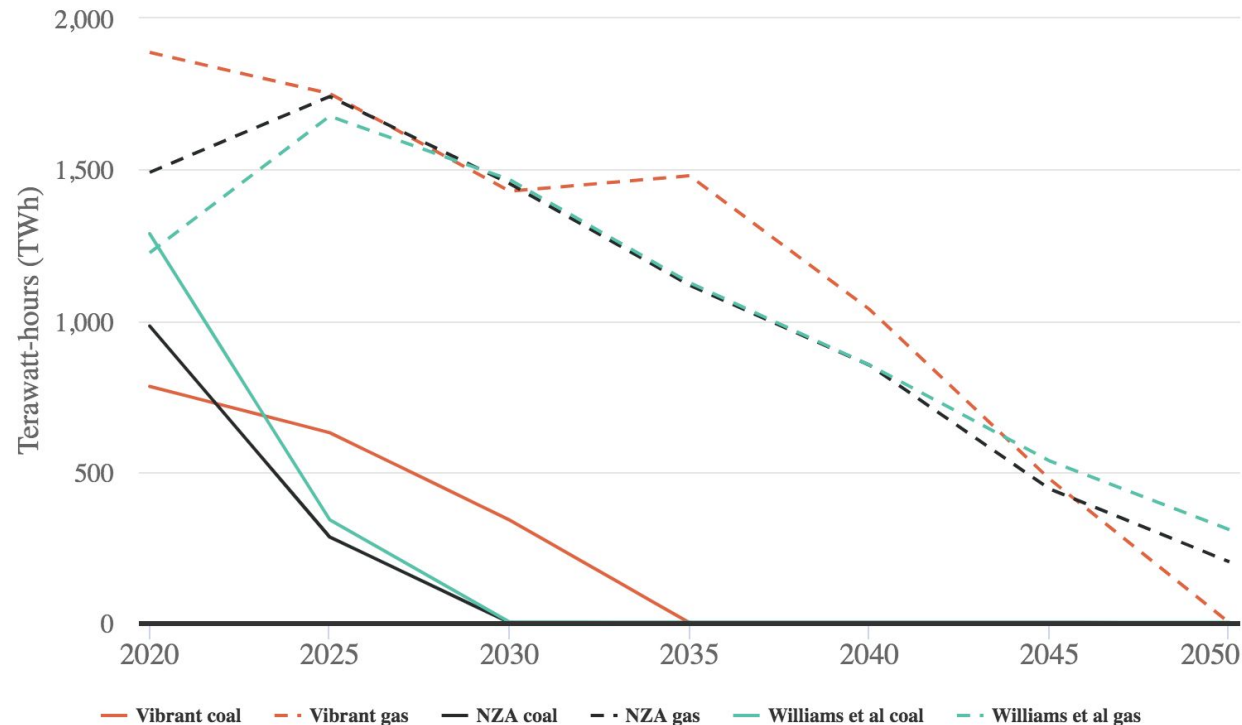
Strong role for new nuclear tech in the Vibrant model

Dispatch of the System

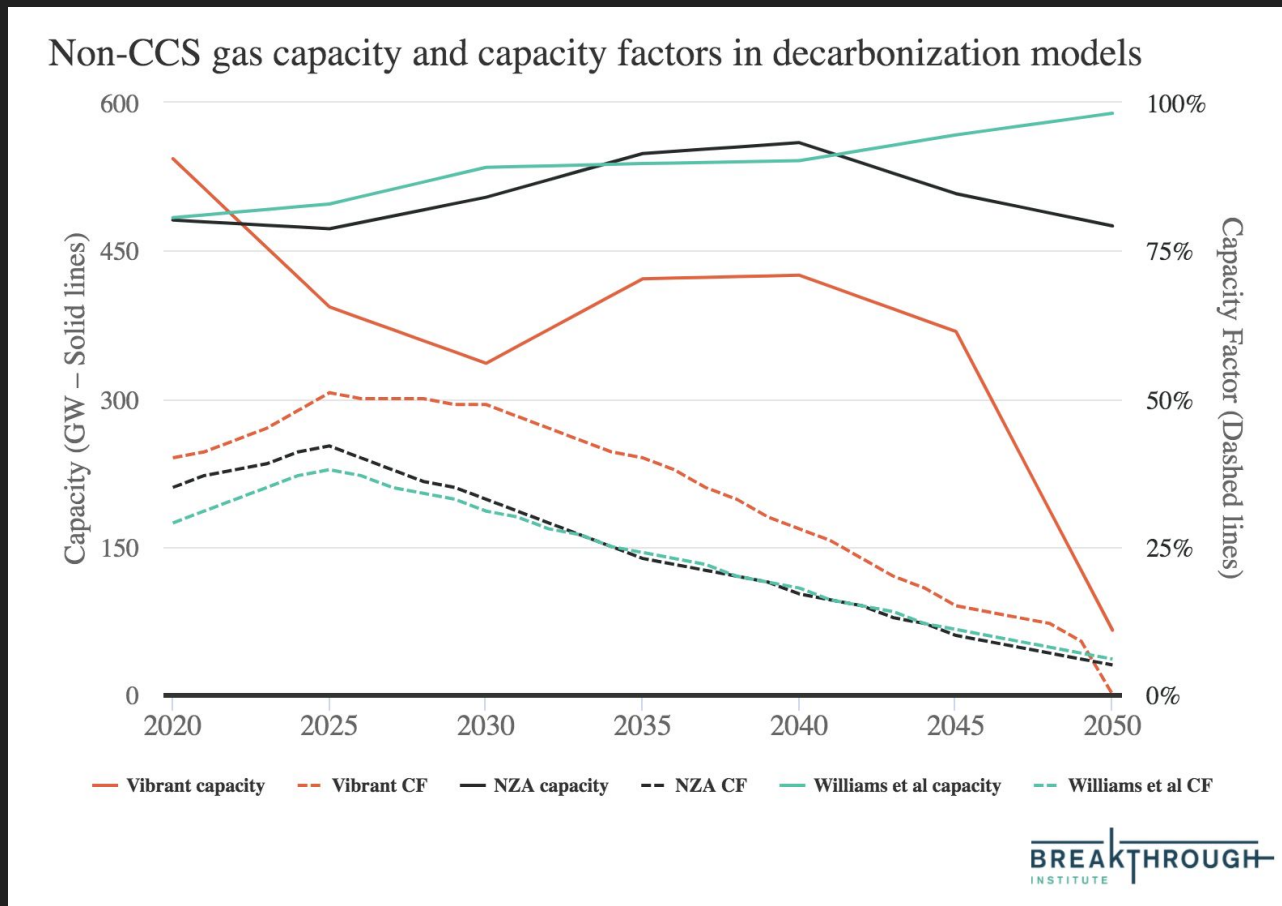


Very different trajectories of coal and natural gas

Coal and Gas (non-CCS) generation across decarbonization models



Gas capacity plays an important long-term role



Takeaways

- Need for clean firm generation in lowest cost electricity sector decarbonization. Models tend to either use nuclear or green hydrogen blended with CH₄, with a smaller role for gas with CCS.
- Deep decarbonization requires both speeding up the deployment of existing clean energy technologies and dramatic expansions of RD&D for clean firm generation and hard-to-decarbonize sectors.
 - “The 2020s is the decade to invest in maturing and improving a range of technologies that improve options for the long term.” - NZA
- Three areas of model agreement:
 - Near-term importance of renewables deployment.
 - Medium-term role of gas capacity to fill in the gaps.
 - Long-term importance of clean firm generation and complementary technologies to wean the power system off its dependence on natural gas.

Thanks!

Questions?

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